T-1018: Testing a Forward Calorimeter System for STAR and Barrel Electromagnetic Calorimeter for an Electron Ion Collider

Jay Dunkelberger

UCLA, TAMU, Penn State, BNL,
LBNL, ITEP, IUCF

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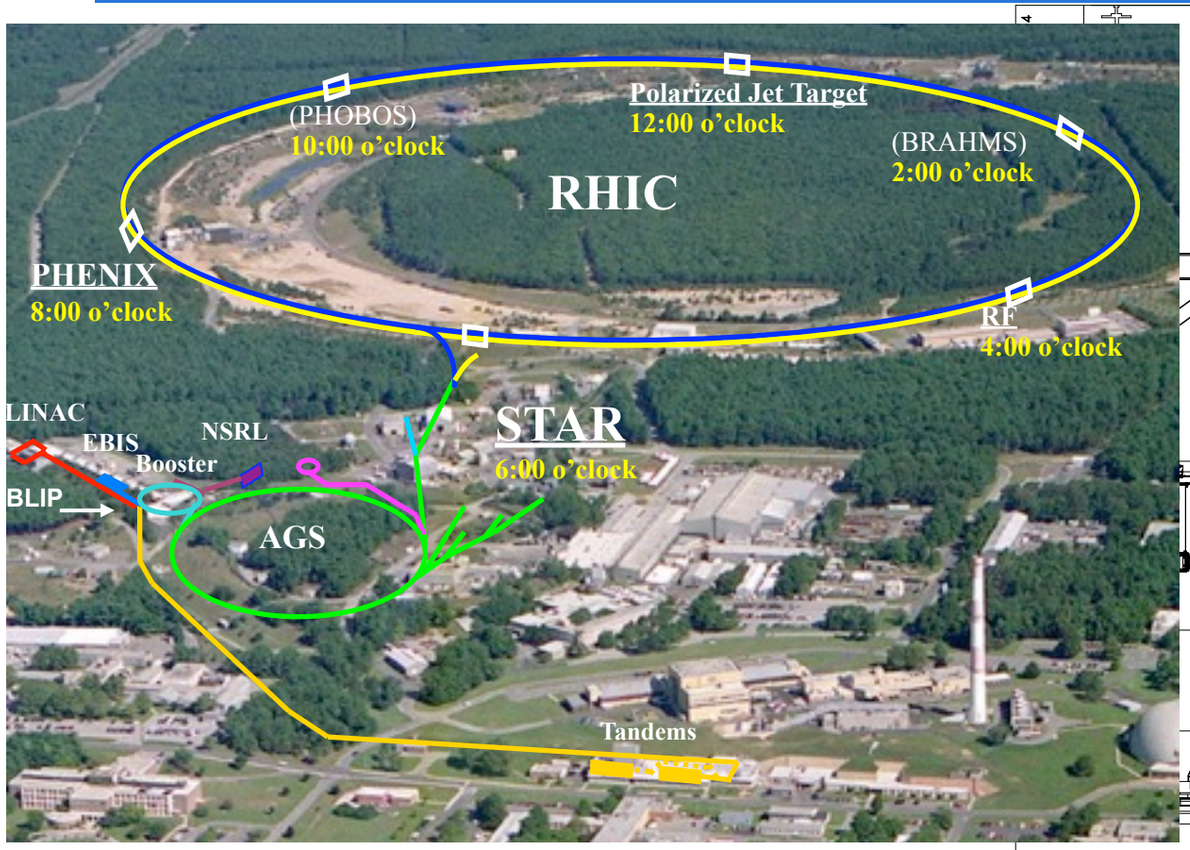
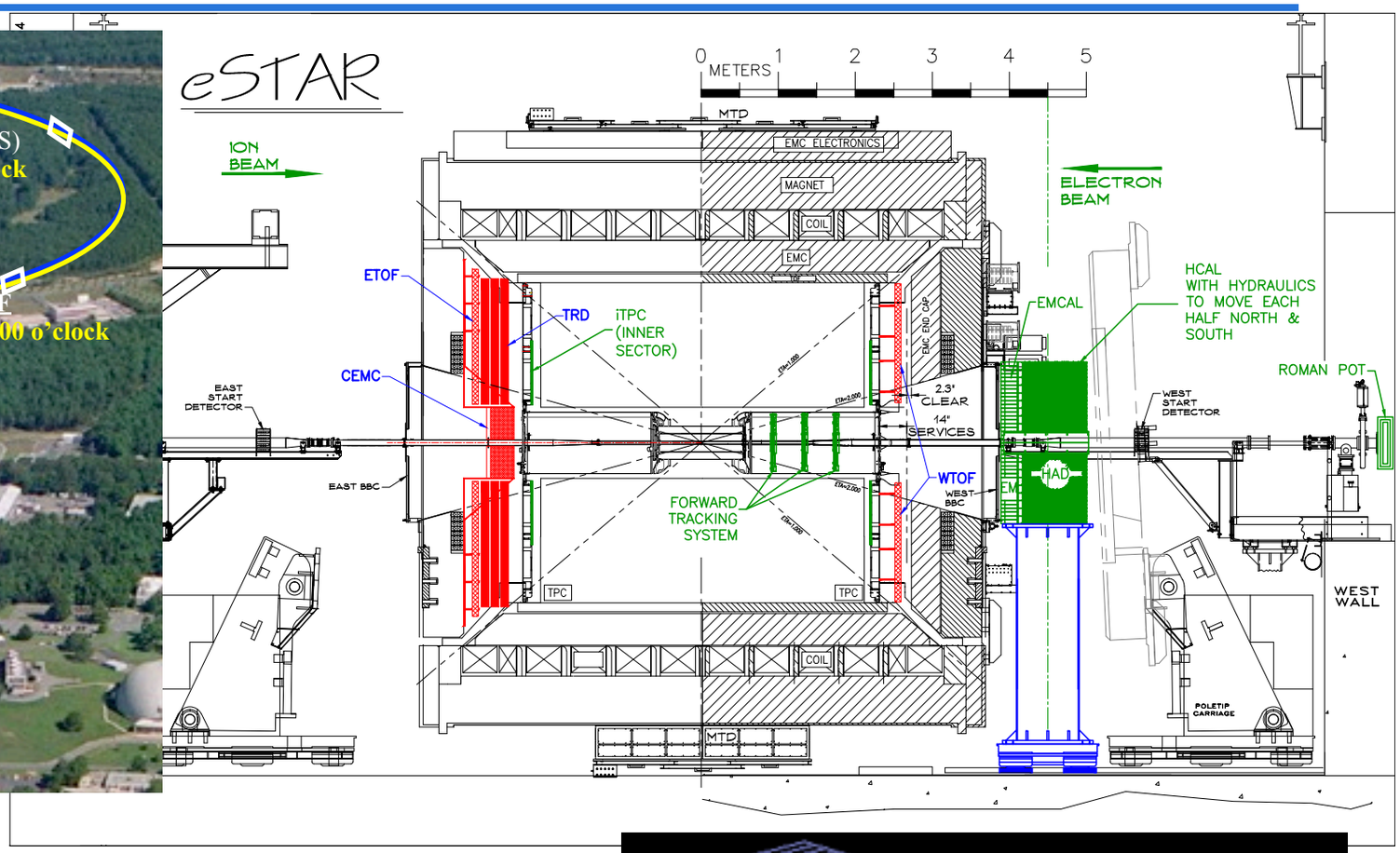
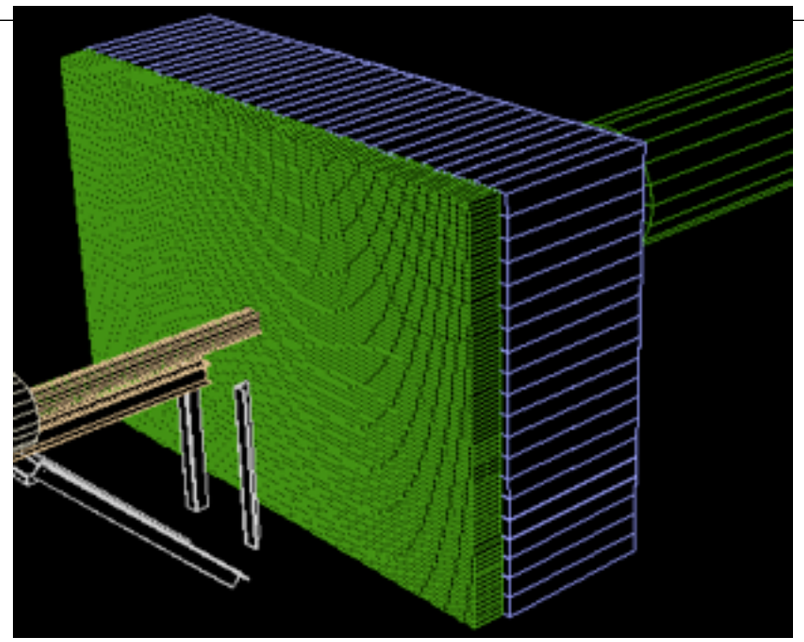
EIC and STAR Calorimetry Needs

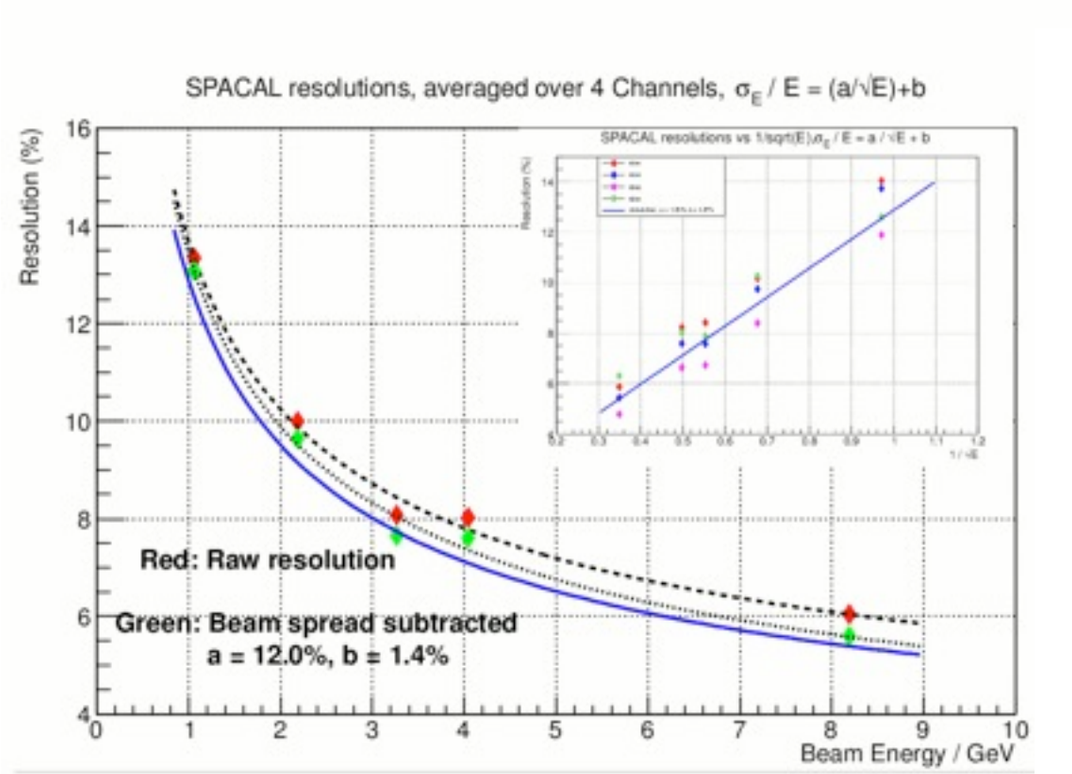


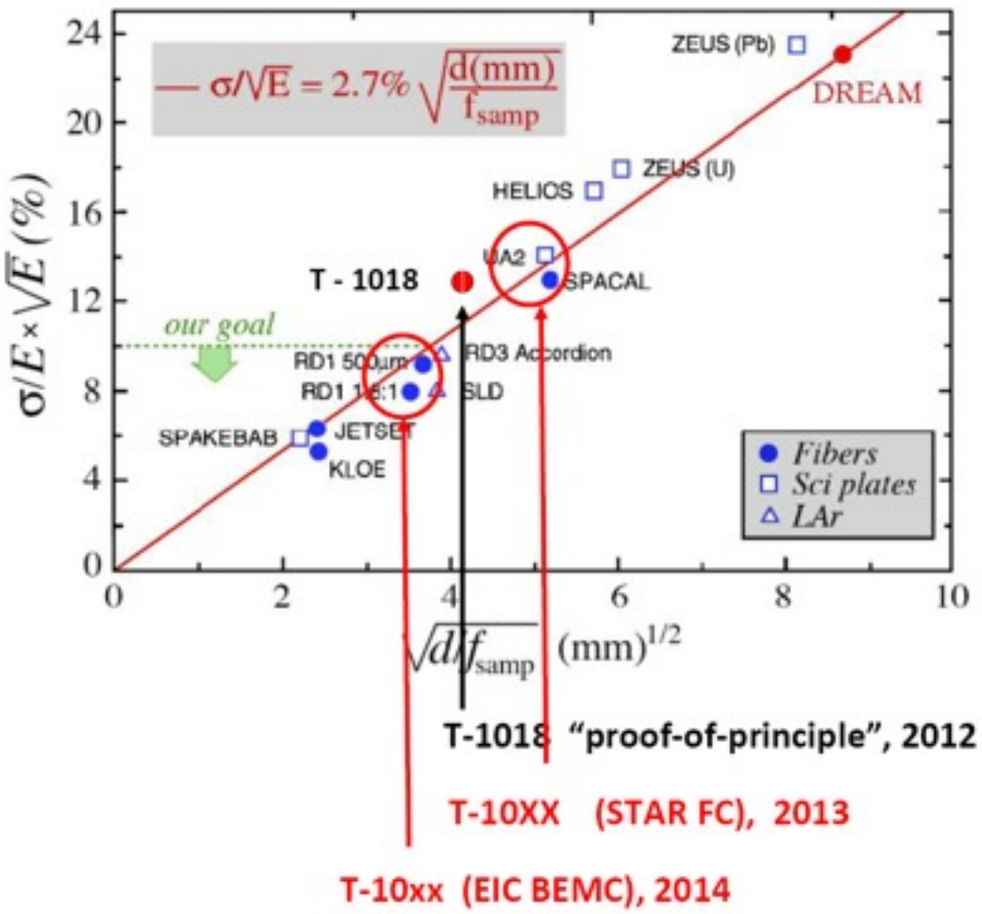


EIC and forward upgrades to STAR will require hadronic and electromagnetic calorimeters with high resolution. Space constraints drive the need for a compact/compensated design.



Previous T-1018 Test Run at Fermilab

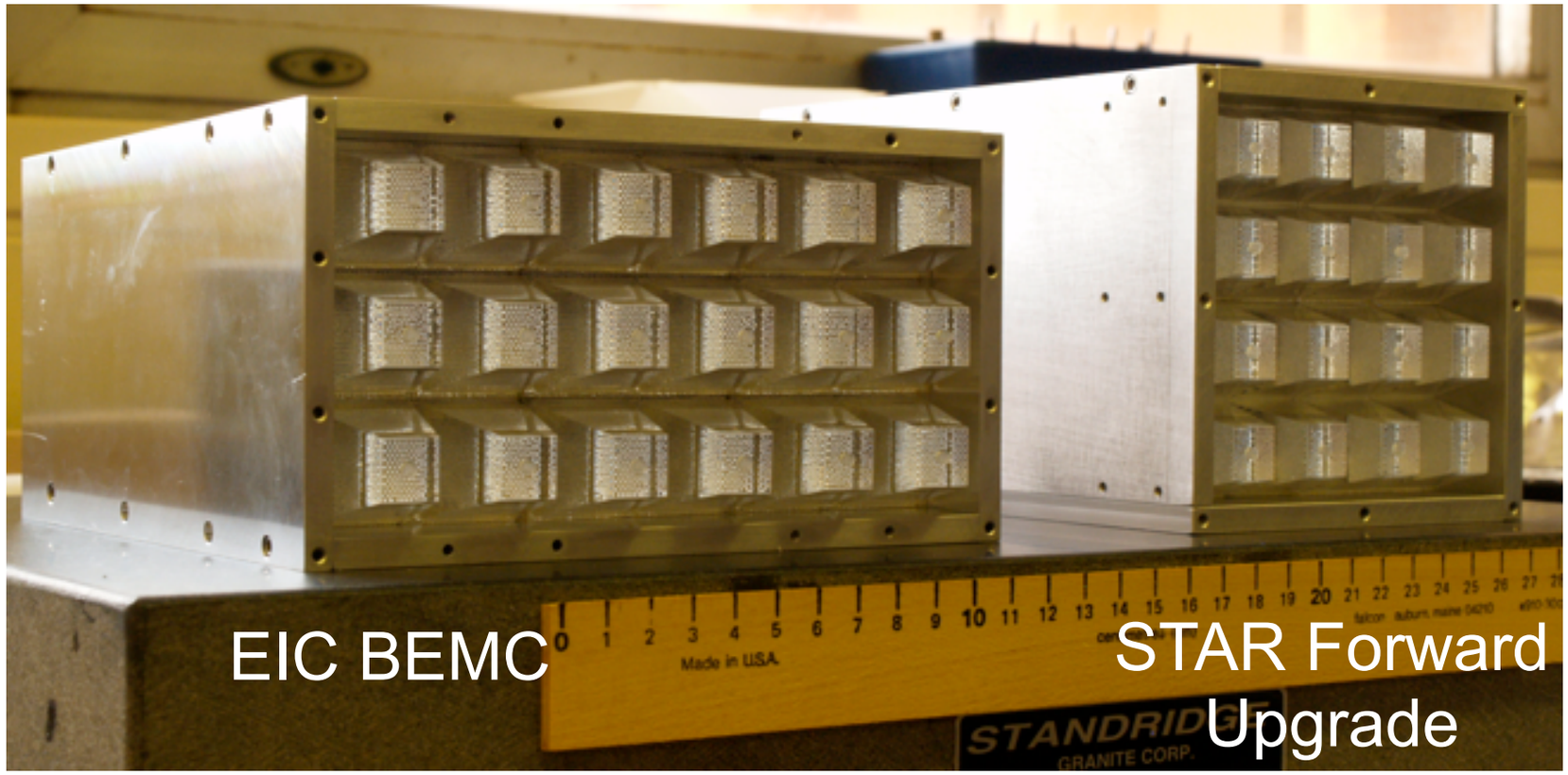


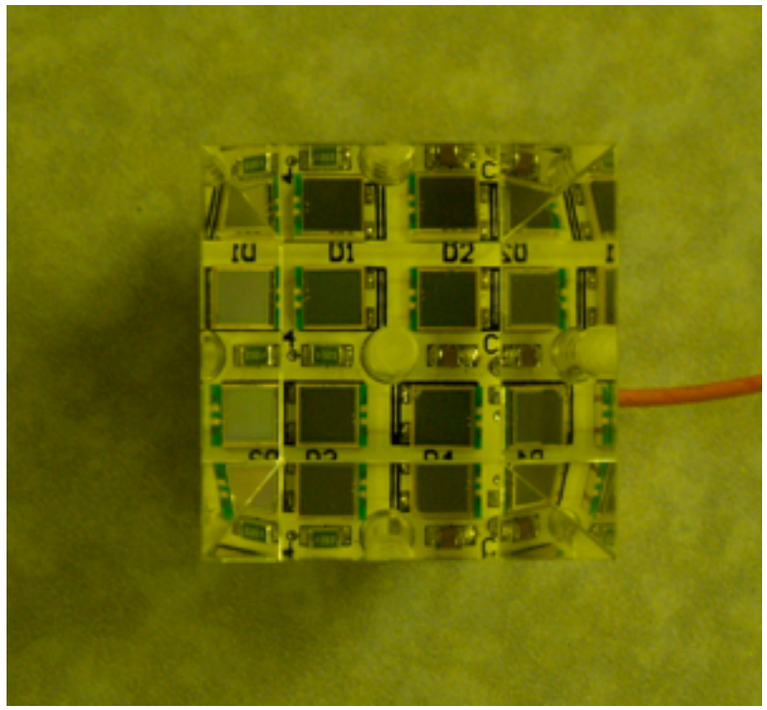


Our successful 2012 test run showed that tungsten powder fiber calorimeters are suitable as EM calorimeters for EIC and the STAR forward upgrade

This year we came to test a combined EMCal and HCal system plus a compact readout scheme

EM Calorimeter

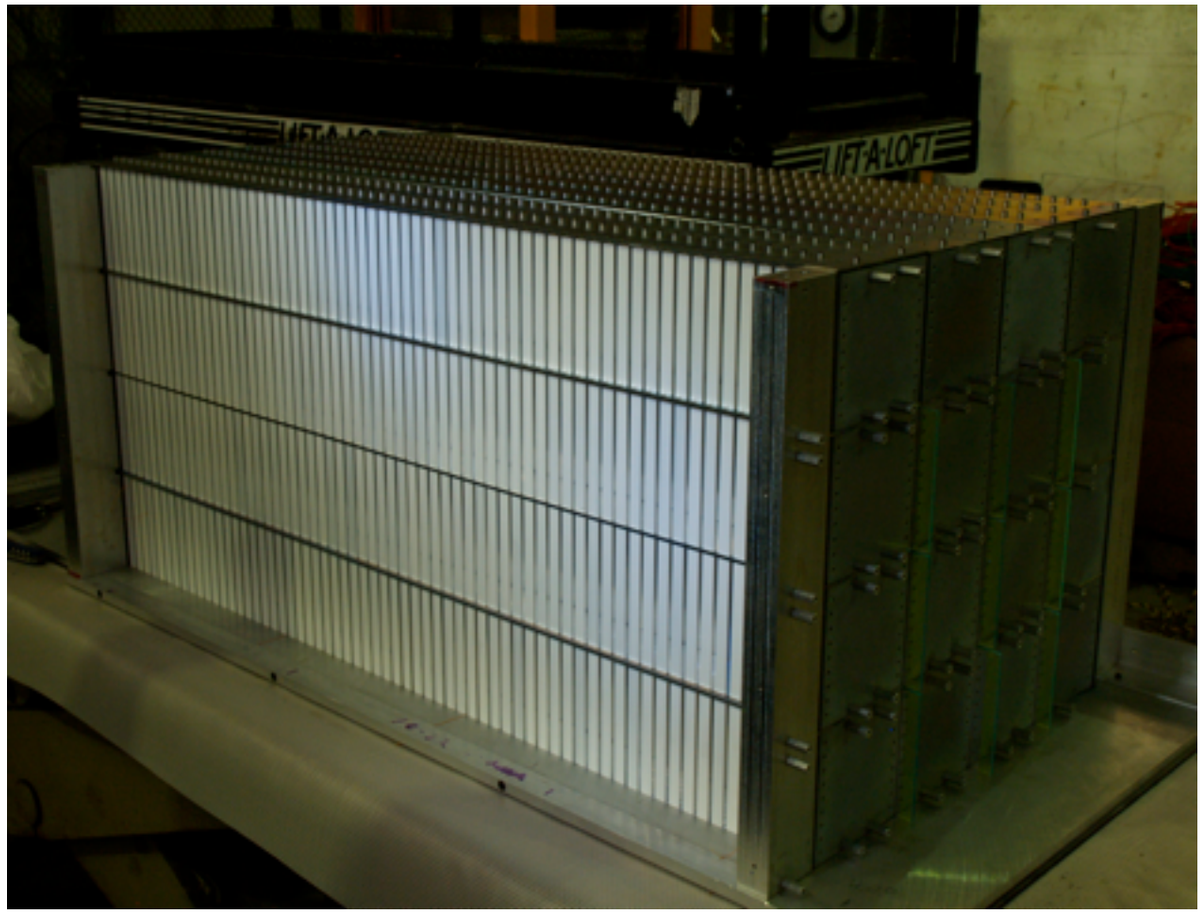


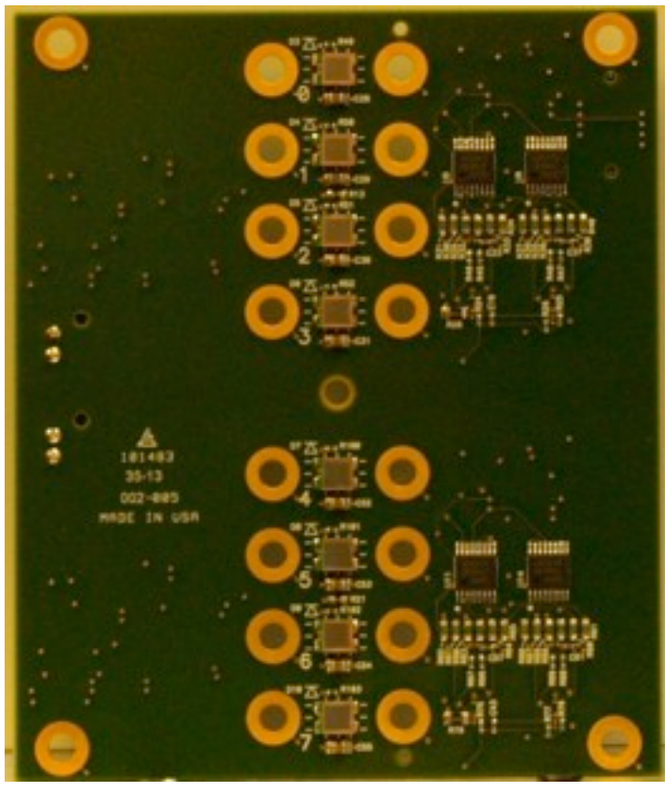


We tested powder/fiber calorimeters as the EM section of the calorimeter system. In 2012 readout was with PMTs, this year we used a compact SiPM readout (~25mm thick)

2 designs with different light collection schemes were tested

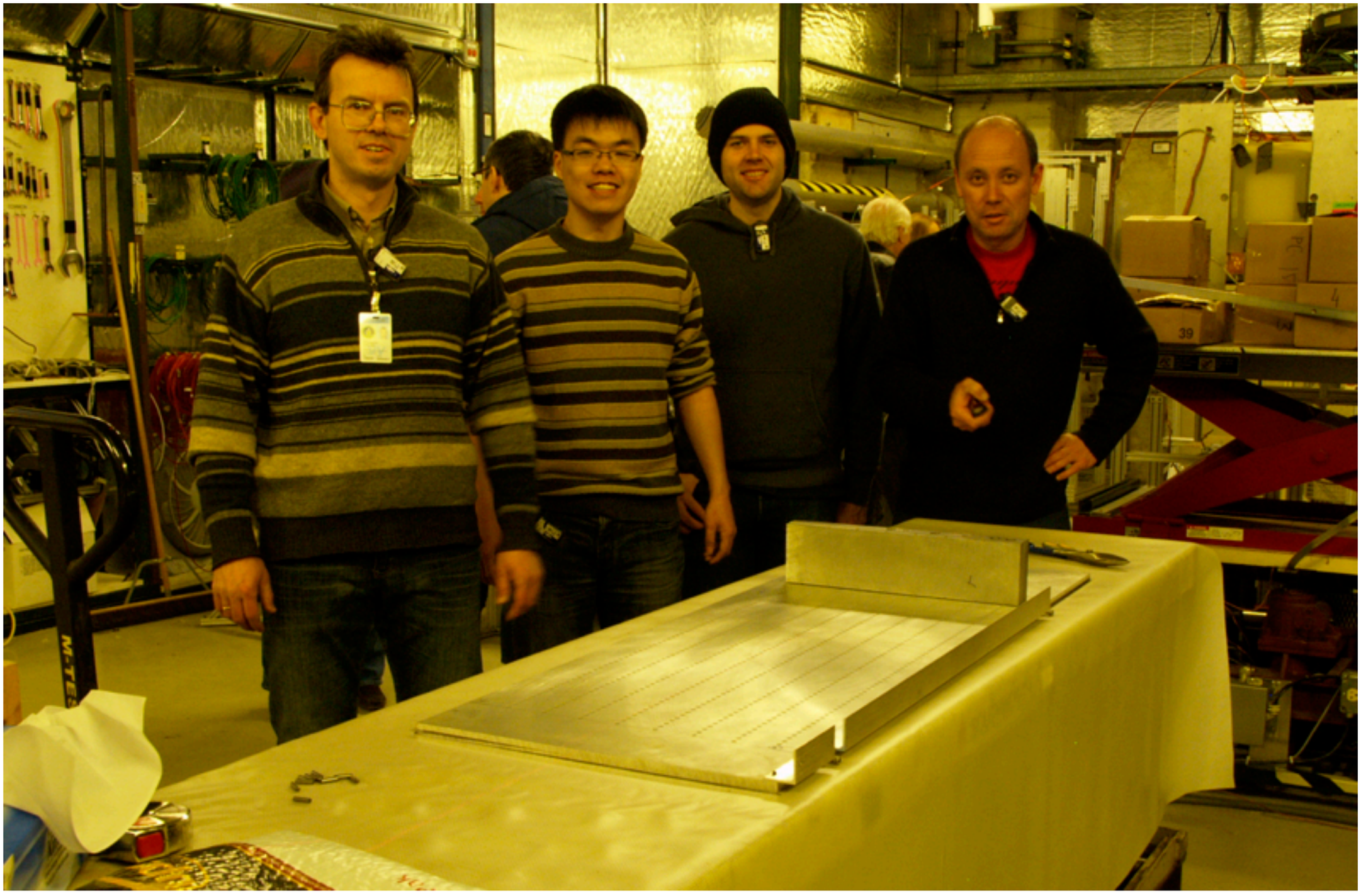
Hadronic Calorimeter





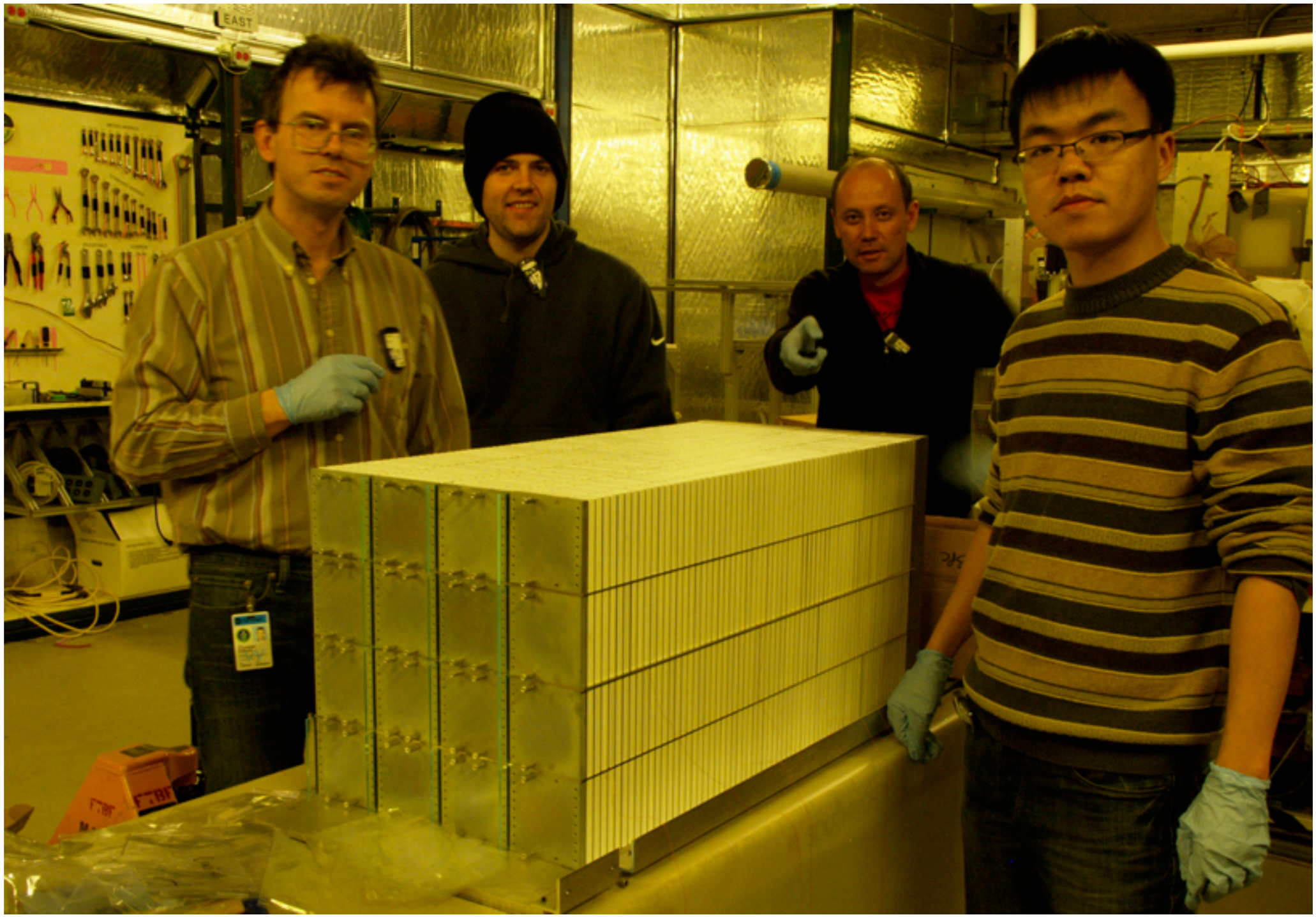
HCal is ~4 interaction lengths Pb/scintillator. Readout is from SiPMs attached to wavelength shifting plates which run the length of the detector.

Assembling HCal Onsite



First Layer Done

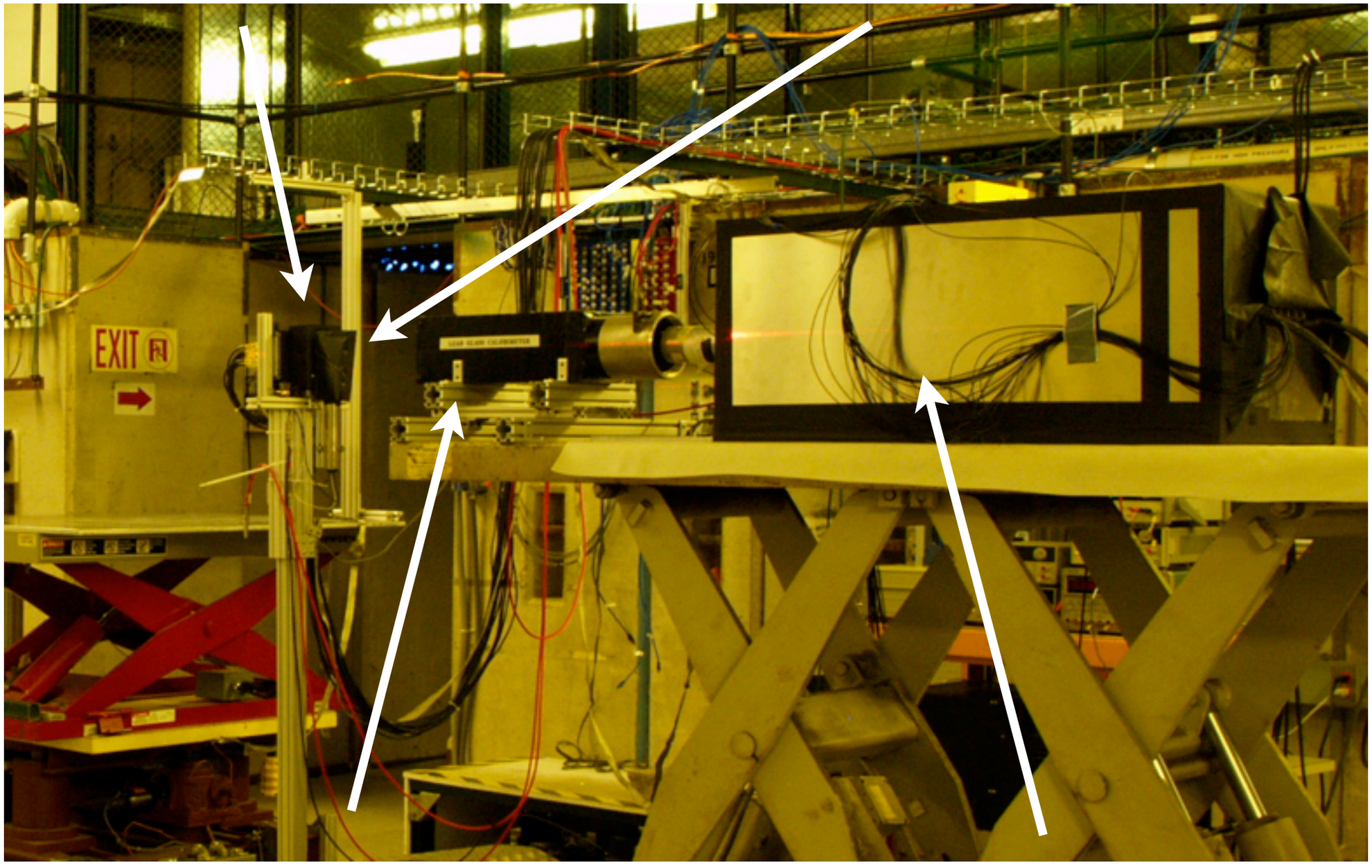
After 8 Hours...



Initial Setup

Hodoscope

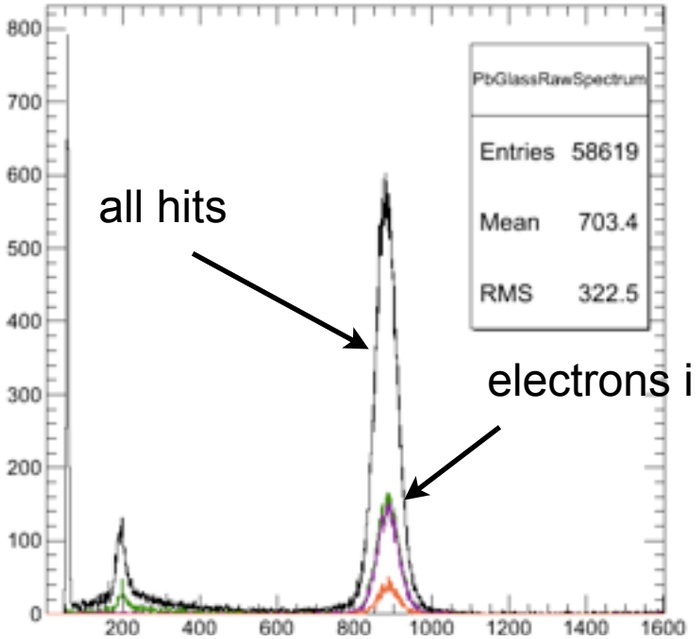
Trigger Counter

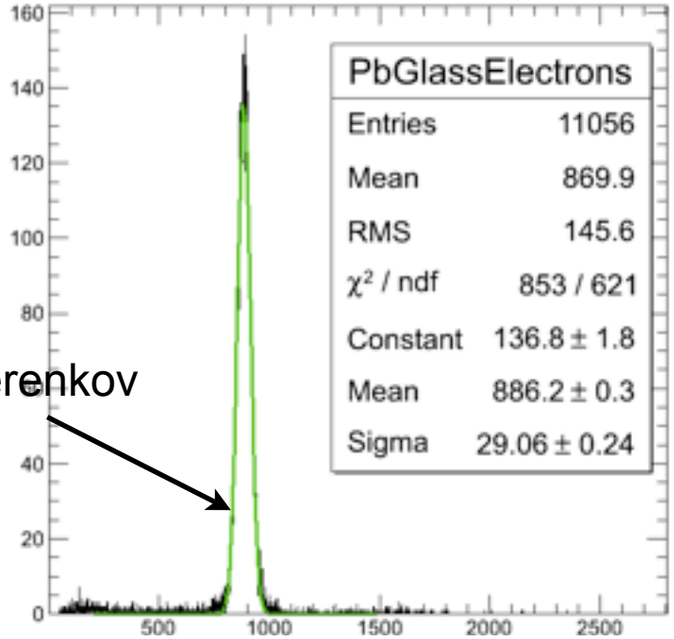


Lead Glass Calorimeter

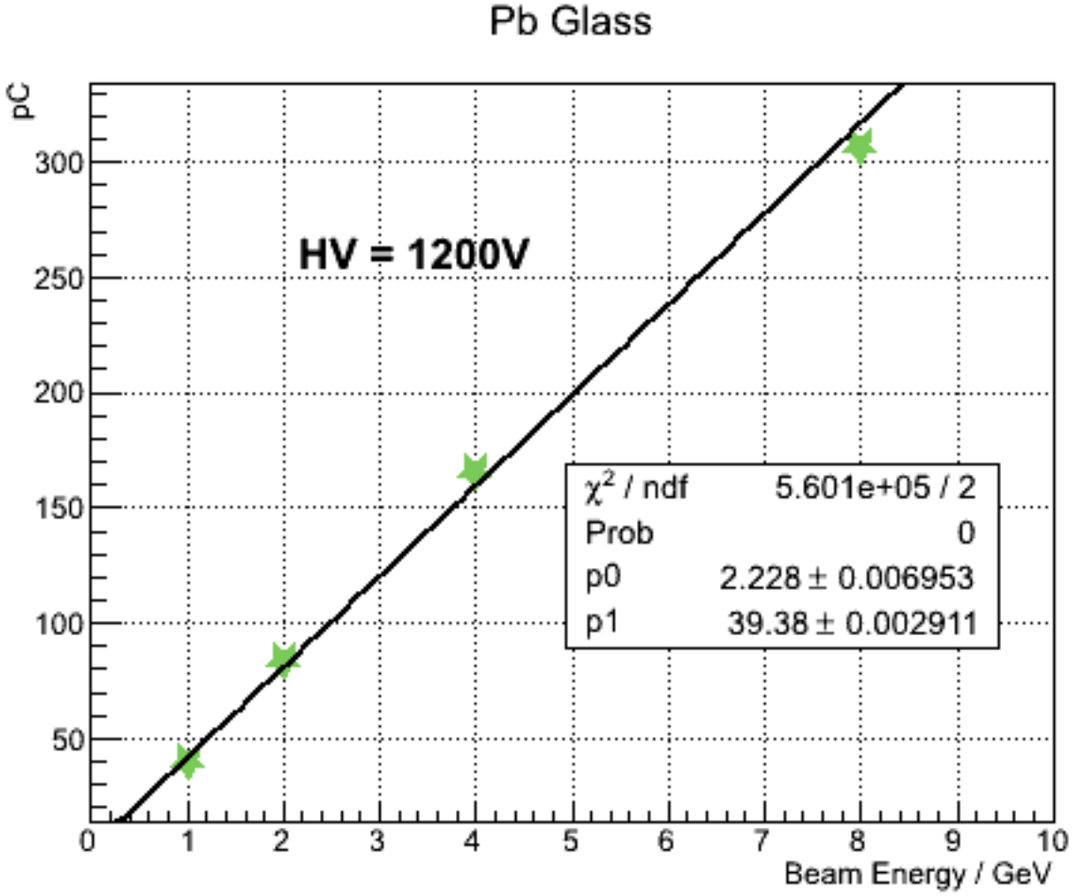
HCal

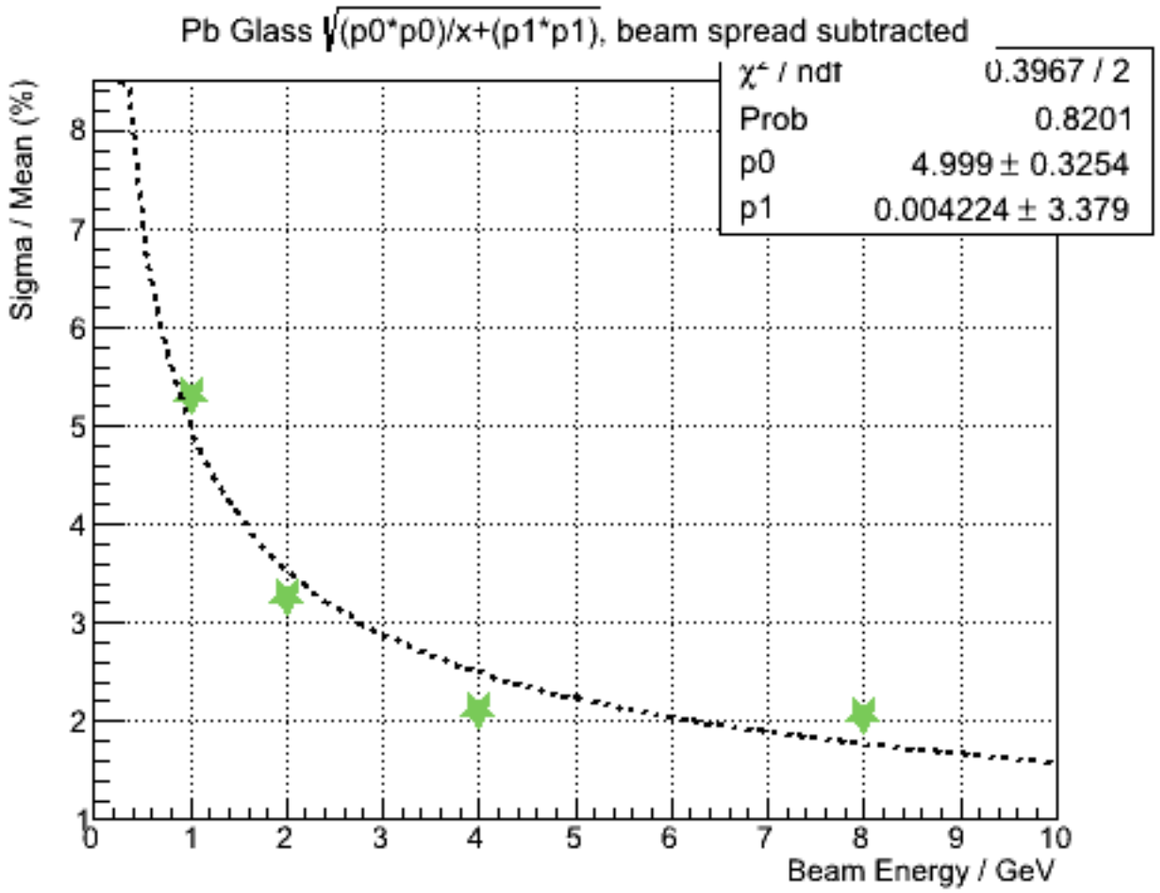
First Results: Check With the Lead Glass



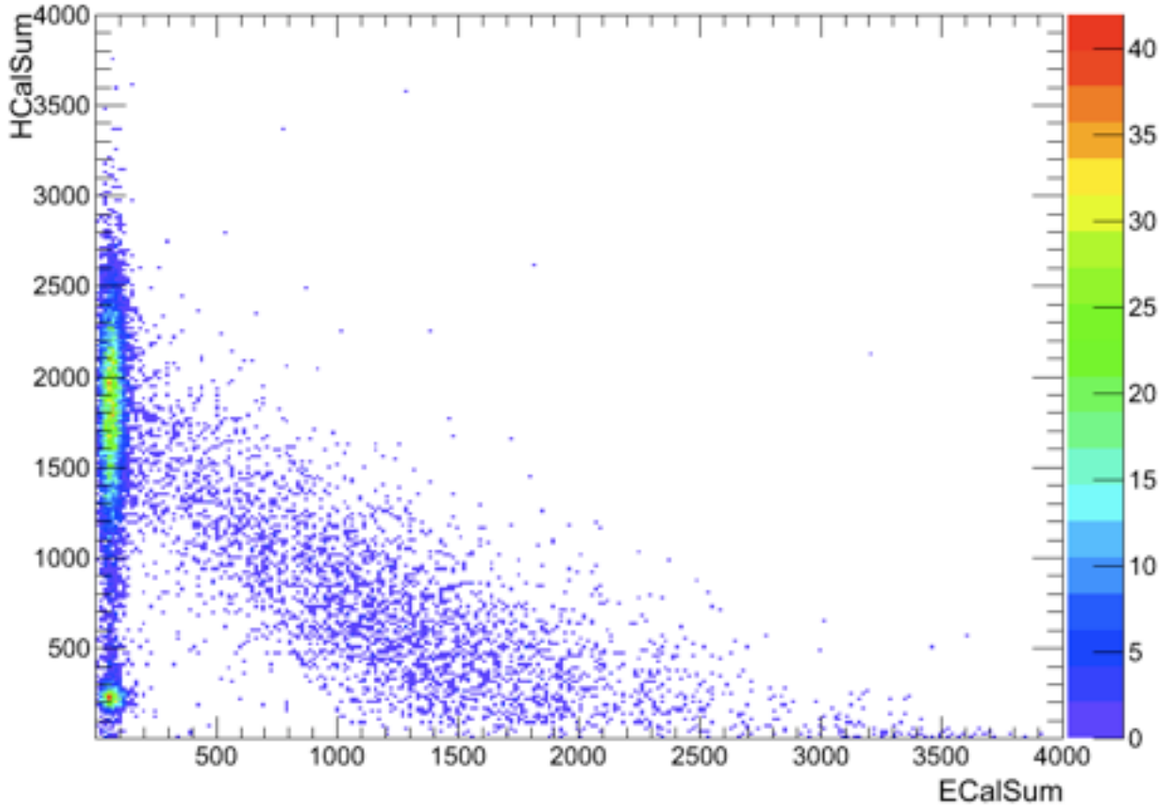


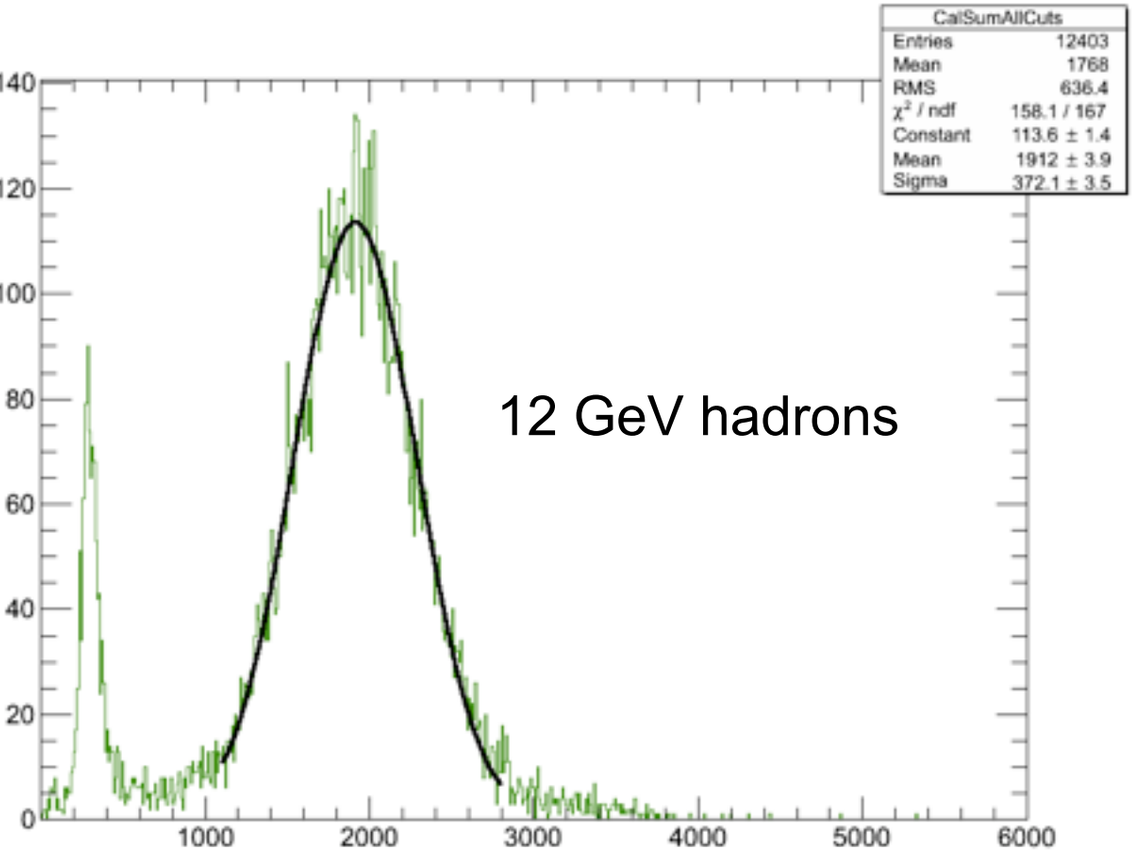
Thank you to FTBF for maintaining this very useful device for users!

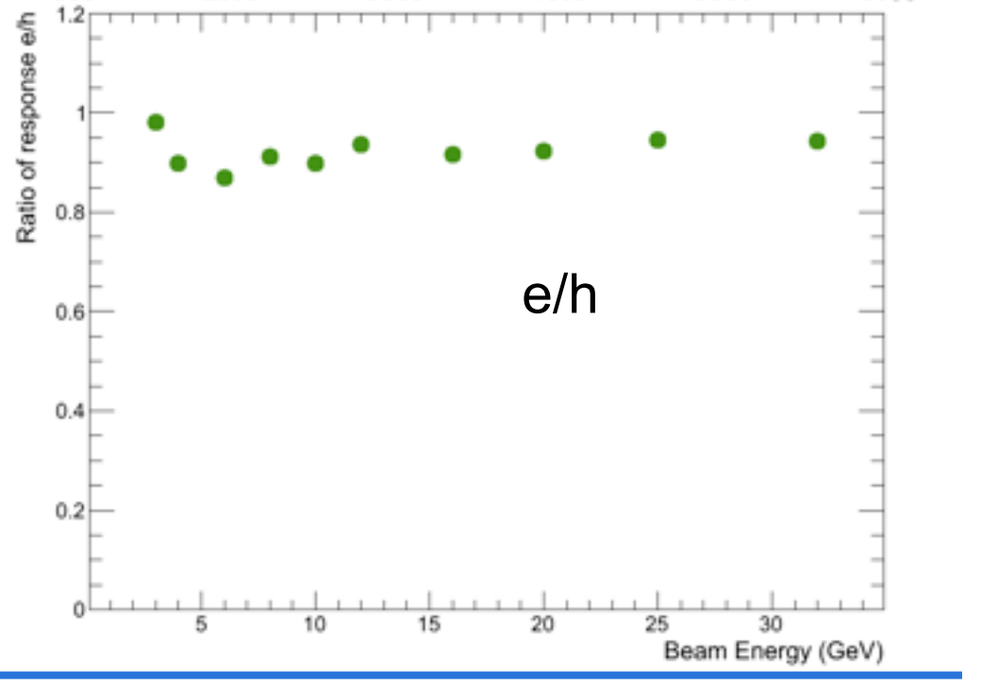




Response to Hadrons in HCal + ECal

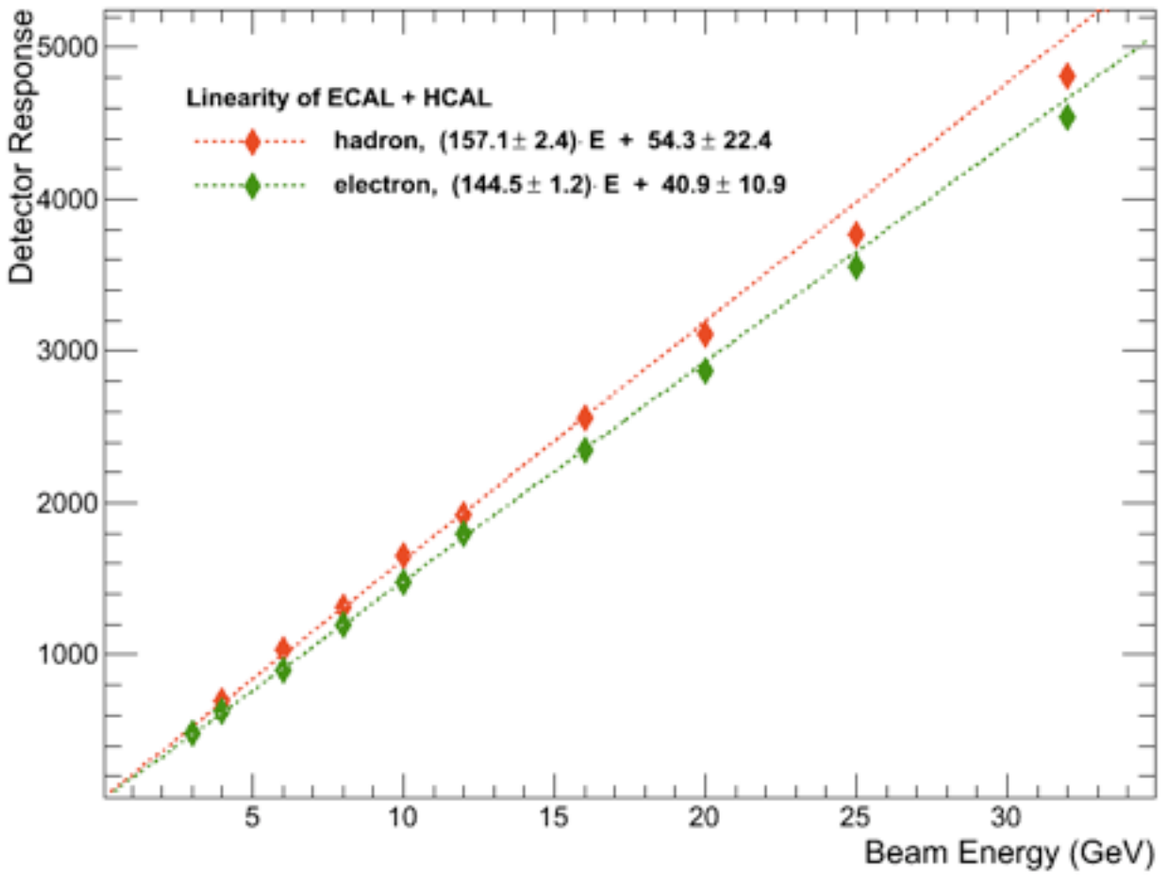


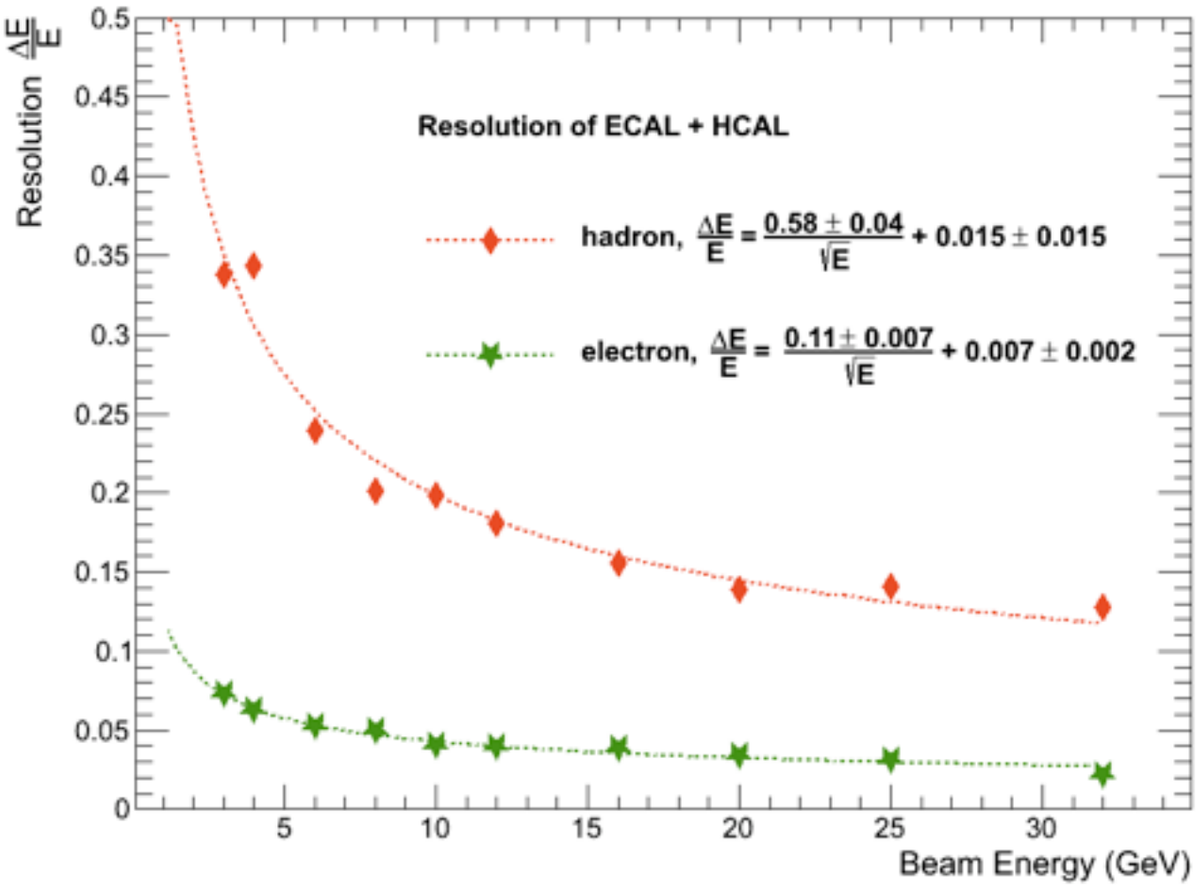




For the HCal + ECal system we see that the combined response to hadrons is gaussian and that the e/h ratio is close to 1 for energies from 6 - 32 GeV

Calorimeter System Performance

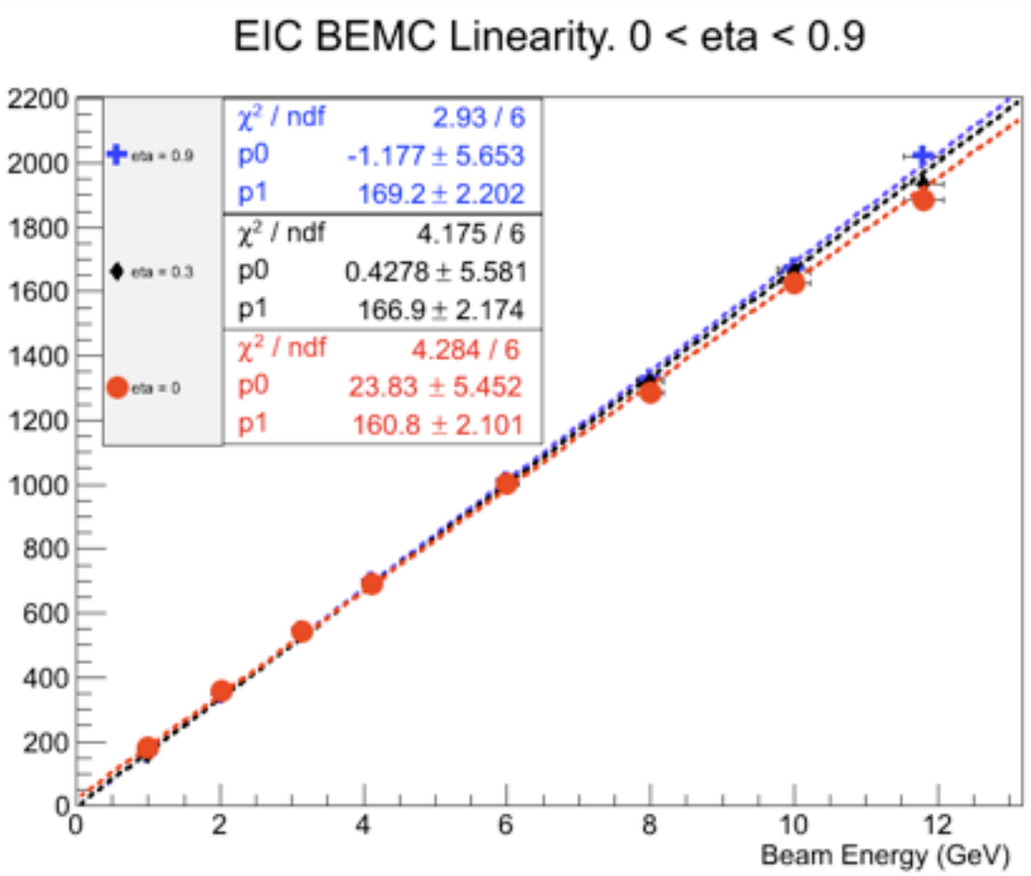


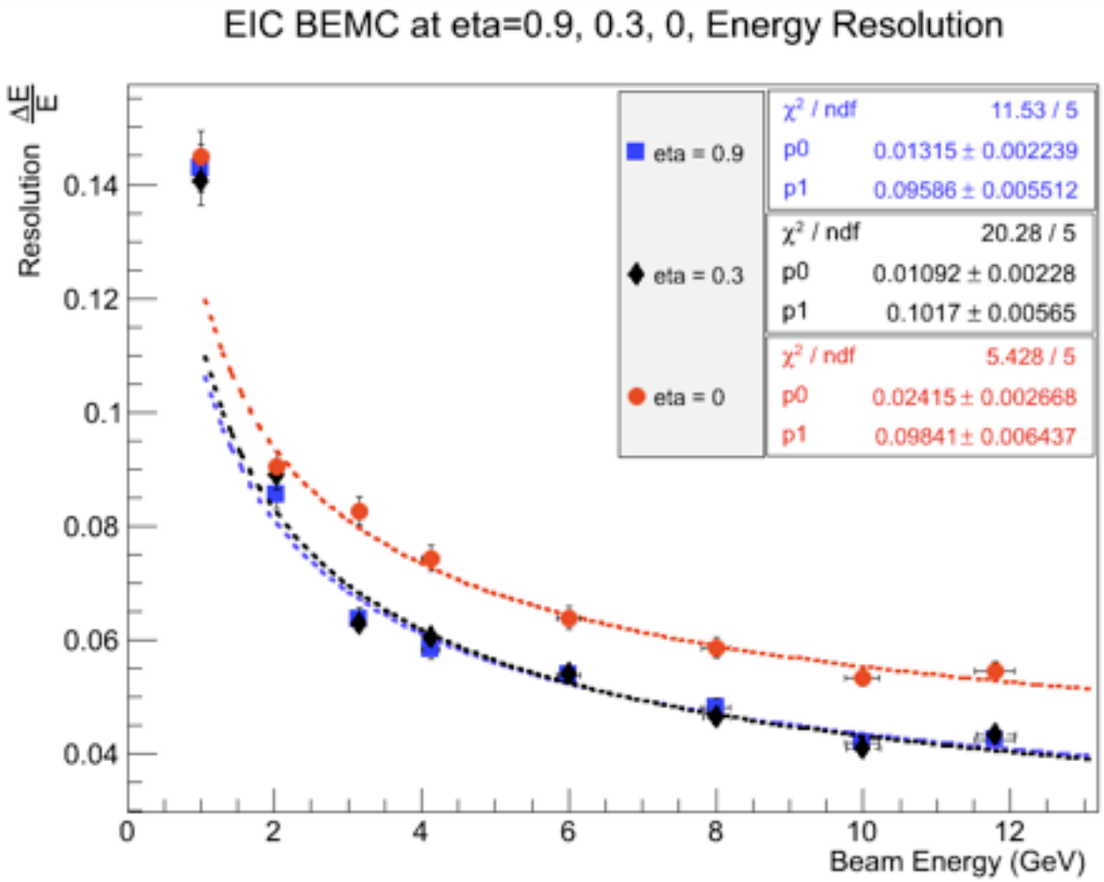


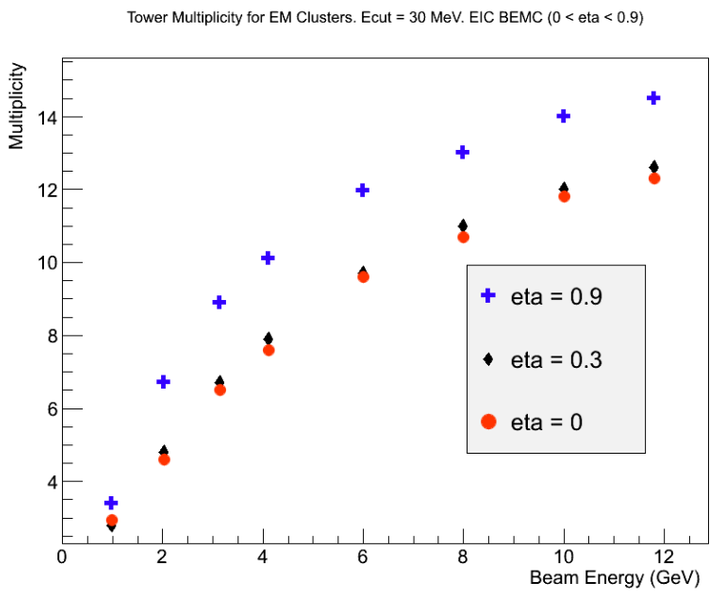
Measured the resolution of the combined ECal and HCal system for beam energies between 3 GeV and 32 GeV. Fits show hadron resolution of 58% which is close to expectations from simulation.

Linearity is good up to 16 GeV, above that showers leaking out of the calorimeter become an issue.

EIC Prototype Results







Initially had lower than expected light yield from EIC BEMC prototype due to the bonding of fibers to mirror.

With painted over mirror we get more light.

We spent a few days investigating how the resolution and multiplicity of the detector varies with incident angle

Conclusion

Another productive test run at FTBF

Calorimeter systems performed near our expectations, and we have plenty of areas to improve for future iterations

We look forward to our next test run at FNAL

Thank you to FNAL, FTBF, and MCR for working hard to make our test run successful!

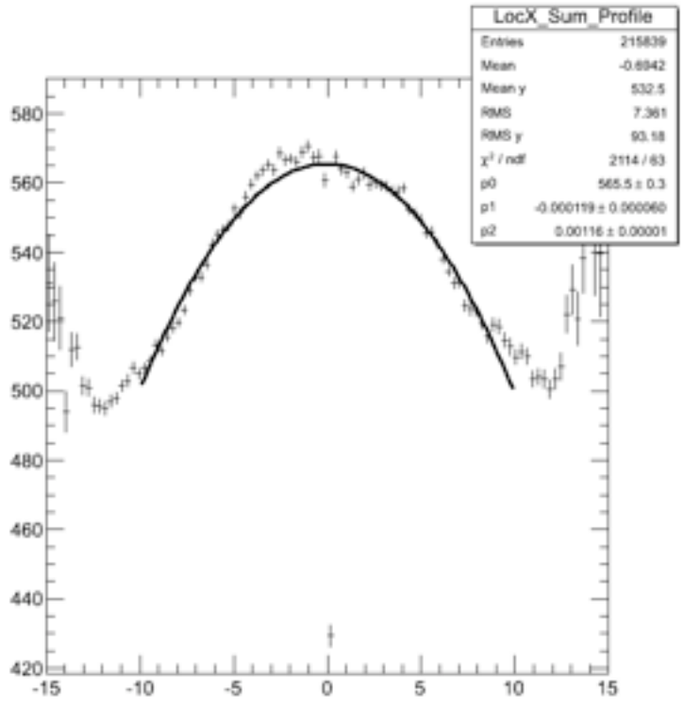
L. Dunkelberger, S. Fazio, A. Kiselev, K. Landry, M. Mondal, Y. Pan, M. Sergeeva, N. Shah, O. Tsai

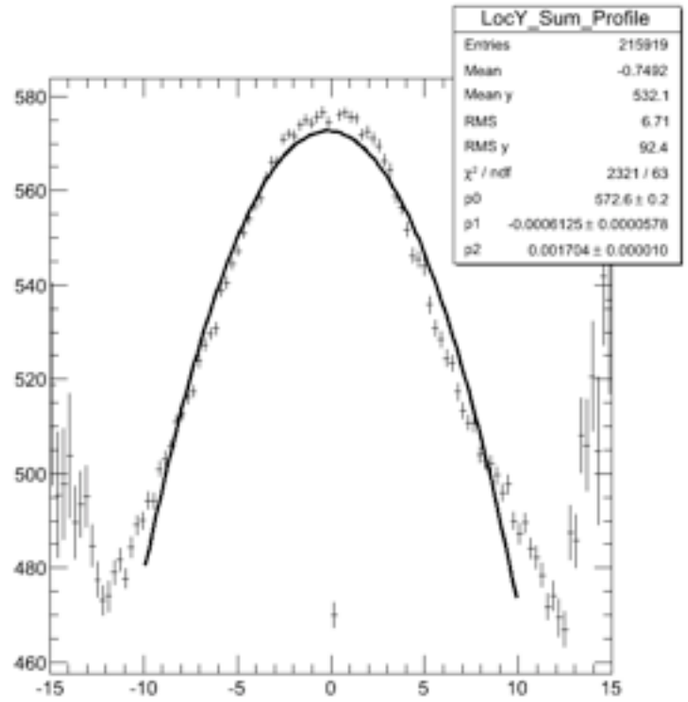
Backup

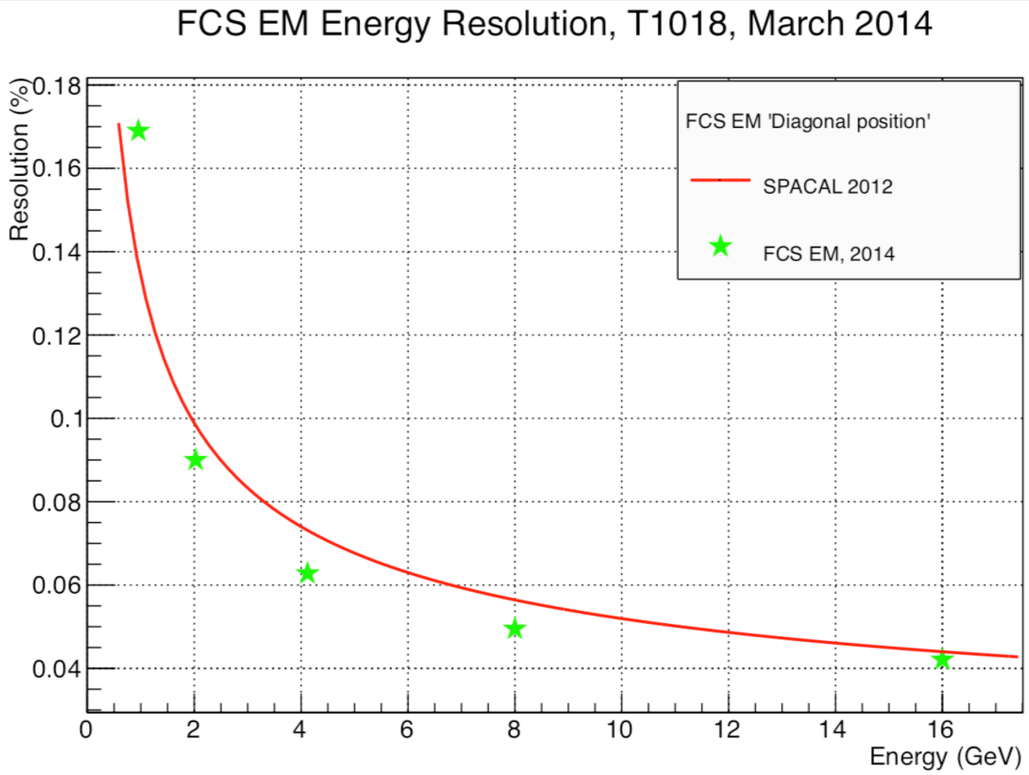
Resolution of EM Cal

Initially had problems with ECal resolution due to non-uniformities in light collection in tower.

We measured the resolution with the detector diagonal to the beam to eliminate this effect, and later we could apply corrections during the data analysis to replicate these results with the detector face-on.







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